

REMARKS

Claims 1-7, 10, 11, and 13-23 were presented for examination and were pending in this application. In the latest Office Action, claims 1-7, 10, 11, and 13-23 were rejected. With this amendment, claims 1 and 2 are amended. On the basis of the following remarks, consideration of this application and the early allowance of all pending claims are requested.

I. Claim Rejections – 35 U.S.C. § 102

Claims 1, 2, 6, 7, 10, 11, 13-15, and 19-23 were rejected as anticipated by U.S. Patent No. 6,515,415 to Han et al. Based on the following, Applicants respectfully assert that the claims are patentable over Han because Han does not disclose each and every limitation in the claims, as amended.

The claims recite an electron-emitting device having electron-emissive elements (such as carbon nanotubes) grown using a seed layer. This seed layer includes multiple sections over the emitter electrode that are laterally separated or otherwise sectioned. Amended claim 1, for example, recites a device that includes an emitter electrode, a gate electrode, and electron-emissive elements over sections of a seed layer situated over the emitter electrode in a composite opening through the gate electrode. Similarly, amended claim 2 recites a device that includes an emitter electrode, a plurality of gate electrodes, and electron-emissive elements grown from a seed layer, where the seed layer includes a plurality of unconnected sections in composite openings through each gate electrode. Lastly, independent claim 13 recites a device with electron emissive elements situated in one or more openings in a gate electrode, as well as a seed layer that includes laterally separated sections, each section of the seed layer electrically coupled between one or more groups of electron-emissive elements and the emitter electrode.

One common feature in each of these claims is that, for a particular pair of gate and emitter electrodes, there are separated or otherwise decoupled sections of a seed layer. Unlike the prior art, therefore, the claimed invention does not merely have a plurality of laterally separated sections of a seed layer. Rather, the claimed invention has a plurality of laterally separated sections of the seed layer for a particular pair of gate and emitter electrodes. This is an important distinction because groups of electron-emissive elements in the device may be addressed by their corresponding emitter-gate electrode pair (e.g., to light a particular pixel or color of a pixel in a display device). As the specification explains, this sectioned seed layer isolates groups of electron-emissive elements for a given emitter-gate electrode pair, thereby providing a number of advantages over previous solutions.

One such advantage is to avoid the deleterious affect that can result due to variations in the length and/or quality of the electron-emissive elements for a given pixel or subpixel. Variations in length or quality of the electron-emissive elements can cause a few of the groups of elements that have a low value of voltage to become the primary source of electron emitting for the entire group of elements – rather than emitting electrons from most of the group of elements. In such a case, the elements acting as the primary source of electron emitting could cause emitter degradation. By having electrically separated groups of electron-emissive elements (e.g., by sectioning the seed layer), the performance of some groups of electron-emissive elements are not affected by variance in the length or quality of other groups of elements for a given pixel or subpixel of a display.

Han does not disclose this claimed feature. As shown in the embodiment of FIG. 13 (the embodiment that uses a seed layer), Han's device includes a plurality of groups of emissive elements, where each group of elements is situated in a particular cavity and grown over a single,

continuous seed layer. Although Han does have multiple sections of the seed layer in the entire device, each seed layer section corresponds to a unique combination of a particular emitter electrode and a particular gate electrode. In other words, Han discloses only one continuous section of seed layer for each addressable combination of emitter electrode and gate electrode. This is seen for example in FIG. 11B, where a single color in a display is addressed by an emitter and gate electrode and is lighted by emissive elements situated on a single, continuous seed layer section.¹

It is thus apparent from Han that it is not a new concept to electrically decouple the emissive elements that correspond to different emitter-gate pairs. Indeed, this may be necessary in some implementations to make the emissive elements matrix addressable, such as where each emitter-gate pair defines a pixel as in Han's display device. But the claimed invention departs from the prior art, in part, because it electrically decouples multiple sets of the emissive elements for a given emitter-gate pair. This is done by sectioning the seed layer on which the emissive elements are grown. It is through this decoupling that the above-mentioned benefits of the claimed invention are achieved.

Because Han does not disclose this claimed feature, claims 1, 2, 6, 7, 10, 11, 13-15, and 19-23 are patentable over Han.

¹ In rejecting claim 23, the examiner asserted that Han teaches multiple sections of the seed layer corresponding to a single color. Applicants respectfully disagree with this assertion. Han's FIG. 11B shows a single, continuous group of emissive elements (121, but not labeled) for each color element (170). Han's FIG. 13B illustrates how the emissive elements in each cavity are grown on a continuous seed layer. Each of these continuous seed layer sections corresponds to a single color (170), which is uniquely addressed by a particular pair of emitter electrode (120) and gate electrode (140).

II. Claim Rejections – 35 U.S.C. § 103

Claims 1, 2, 5-7, 10, 11, 13-15, 17, and 19-23 were rejected under 35 U.S.C. § 103 as unpatentable over U.S. Patent No. 6,144,144 to Cleeves et al. in view of U.S. Patent No. 5,973,444 to Xu et al. Applicants respectfully assert that the claims are patentable because the proposed combination does not describe or suggest each and every claimed limitation of the rejected claims.

Cleeves describes an electron-emitting device having emitter and gate electrodes, anodes, and conical emissive elements situated in openings in the gate electrodes. Xu discloses carbon nanotubes, which can be formed on a seed layer. Because Cleeves does not disclose a seed layer used to form the emissive elements, the examiner proposed substituting the emissive elements and seed layer described in Xu for the emissive elements in the device of Cleeves. Applicants respectfully assert that this combination would still fail to achieve the claimed invention because there is no disclosure in either Cleeves or Xu of laterally separated (or otherwise electrically decoupled) sections of the seed layer for a particular pair of gate and emitter electrodes.

Assuming one of skill in the art were motivated to substitute Xu's carbon nanotubes for the emissive elements of the Cleeves device, as proposed in the Office Action, the question of how to do so remains. As explained in the background section of the present application and as shown in the corresponding prior art FIG. 1, the previous solution was to lay a common seed layer over an emitter electrode and a resistor layer, then lay dielectric and gate layers over the seed layer, and then form a cavity through the dielectric and gate layers in which the carbon nanotubes can be grown. But this would simply result in a seed layer that electrically couples all of the emissive elements for a given gate-emitter pair, thus suffering from the drawbacks explained above. A suggestion to achieve the claimed invention is therefore lacking.

Nor is the needed suggestion found in the cited art. Absent from both Cleeves and Xu is any teaching whatsoever of having laterally separated sections of the seed layer for a particular emitter-gate pair. Although Xu's sections may be laterally separated between pixels (e.g., emitter-gate pairs), this is not the same as the claimed invention for the reasons set forth in the previous section above. Xu, in fact, specifically teaches the opposite. Each of Xu's embodiments illustrates forming emissive elements on a single, continuous seed layer in a cavity or opening (see FIGS. 3-8). In turn, each section of the seed layer – as well as the electrically coupled emissive elements formed thereon – corresponds to a particular pair of gate and emitter electrodes (as shown in FIGS. 9A-C). Therefore, Xu does not disclose having multiple separated seed layer sections for a particular emitter and gate electrode pair, unlike the claimed invention.

It is thus shown that both references lack any suggestion to have laterally separated sections of a seed layer for a particular pair of gate and emitter electrodes. Because it cannot be obvious to implement Xu's emissive elements in the Cleeves device in a way that is not even contemplated by Xu's disclosure, the claimed feature cannot be obvious based on a combination of Cleeves and Xu. Accordingly, claims 1, 2, 5-7, 10, 11, 13-15, 17, and 19-23 are patentable over the proposed combination.

Dependent claims 3 and 18 were rejected under 35 U.S.C. § 103 as unpatentable over Cleeves in view of Xu, and in further view of U.S. Patent No. 6,204,597 to Xie et al. Dependent claims 4 and 16 were rejected under 35 U.S.C. § 103 as unpatentable over Cleeves in view of Xu, and in further view of U.S. Patent No. 5,831,378 to Rolfson et al. In each of these rejections, the same combination of Cleeves and Xu as described above was applied, and the additional reference was cited only for its purported disclosure of the

additional dependent claim limitations. Therefore, it is respectfully asserted that claims 3, 4, 16, and 18 are patentable for the same reasons set forth above.

III. Summary

Based on the foregoing, the application is in condition for allowance of all claims, and a Notice of Allowance is respectfully requested. If the examiner believes direct contact would help advance the prosecution of this case to allowance, the examiner is encouraged to telephone the undersigned at the number given below.

Respectfully submitted,

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